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A SPRAY FOR DESTROYING OVERWINTERING LARVAE
OF THE CODLING MOTH ON APPLE TREE TRUNKS

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A spray for destroying the overwintering larvae of the codling moth (Carpocapsa pomonella L.) on the trunks of apple trees has been developed by the Bureau of Entomology and Plant Quarantine at Yakima, Wash. (1-5, 8-13). This spray consists of a toxicant, 4,6-dinitro-o-cresol, in stove oil emulsion and, in one formula, a penetrant material. It is applied as a dormant spray to the scaffold limbs, the trunks, and the soil at the base of the trees. Several seasons' trials in large-scale orchard tests have given from 80 to 95 percent kill of all worms on the sprayed parts of the trees.

The dinitro trunk sprays not only destroy the overwintering larvae present at the time they are applied, but their toxicity persists and they continue to kill some of the larvae cocooning in the sprayed portions for many months afterwards (3, 7). It has also been demonstrated that, when applied to the trunks and lower scaffold limbs in mid-July, these sprays will kill most of the larvae present and also those that contact the sprayed surfaces throughout the remainder of the season (5).

Two formulas have been developed, one a comparatively stable emulsion containing a penetrant, and the other a quick-breaking emulsion without a penetrant. The second, or modified, formula was developed because the penetrant materials were unavailable during the war. Although not quite so good as the penetrant formula, it has given fair kill. The penetrant materials are now available, but their high price practically doubles the cost of the spray mixture.

These formulas and the directions for preparing and using them are given below.

^{1/} The writers are indebted to W. E. Westlake, Division of Insecticide Investigations, and C. C. Cassil, formerly of that Division, for cooperation and advice.

Penetrant Formula

(Quantities for 100 gallons of spray mixture)

4,6-Dinitro- <u>o</u> -cresol	4 pounds
Stove or Diesel oil (32+ sec. Saybolt)	10 gallons
Emulsifier: Triton B-1956 ^{2/} or Tergitol No. 7 ^{3/}	4 pints
or sodium lauryl sulfate	4 pounds
Penetrant: Butyl Cellosolve ^{4/} and trichloroethylene	1 1/2 gallons of each

The dinitro-o-cresol comes in coarse granules, designated as the "grape nuts" type. These granules must be dissolved in the oil. This is best done by warming the oil to about 167° F. and stirring the dinitro compound into it. The oil should not be allowed to boil. This operation should be carried on outdoors over a covered fire to prevent the oil from catching fire. It is not necessary to heat all the oil to dissolve the dinitro, but at least 6 gallons should be used for each 4 pounds of granules. The remainder of the oil can be added cold. While the dinitro is being dissolved, a spray tank should be partly filled with water, the engine started, and the emulsifier added. When the dinitro is completely dissolved in the oil, the solution should be pumped through the suction hose into the tank, followed by the remainder of the oil. As soon as the dinitro solution is thoroughly emulsified in the spray tank, the penetrant materials should be added, and finally the remainder of the water. The spray is then ready to use. Since this formula gives a fairly stable emulsion, it can be allowed to stand a few hours if necessary, but a few minutes' agitation will be required to re-emulsify it before it is used.

Modified Formula

(Quantities for 100 gallons of spray mixture)

4,6-Dinitro- <u>o</u> -cresol	3 pounds
Stove or Diesel oil (32+ sec. Saybolt)	15 gallons
Emulsifier: Triton B-1956, Tergitol No. 7, or sodium lauryl sulfate	1/2 pound
Ferric chloride, 1/8 oz. dissolved in water	1 pint

This formula is prepared in the same manner as the penetrant formula. The ferric chloride solution is added after the spray mixture is otherwise completed, and the agitator is kept running until the tank has been emptied. This formula gives a quick-breaking emulsion which separates rapidly upon standing, and it will be necessary to re-emulsify it by several minutes' agitation after it has remained unagitated for even a few minutes.

^{2/} A glycerol phthalic alkyd resin.

^{3/} A sodium sulfate of a higher secondary alcohol.

^{4/} Ethylene glycol monobutyl ether.

At least one proprietary concentrate based upon this modified formula has been in use during the last three seasons. This concentrate contains the dinitro-o-cresol dissolved in acetone and the emulsifier, but the user must add the stove or Diesel oil and the ferric chloride as directed. The mixture must be thoroughly emulsified by pumping it through a small injector (6) or the regular suction hose.

Directions for Use

1. These sprays are very toxic to plants and will kill or injure fruit or foliage buds drenched with them. They should therefore be applied only to the trunks, scaffold limbs, and the soil at the base of the trees.
2. To prevent separation of the quick-breaking emulsion, increase the speed of the agitation above that ordinarily used. Owing to the danger of the emulsion separating in stationary pipe lines, it should be used only with portable spraying machines.
3. To avoid breaking the emulsion, it is best to finish spraying a tank before quitting.
4. To avoid wasting the material and insure a thorough application, the spray should be applied at a pressure of 150-200 pounds per square inch.
5. Use either spray rods, 5 to 8 feet long, equipped with Bordeaux or similar type nozzles on an angle, set to deliver about 1 gallon per minute, or spray guns with No. 2 or 3 disks. Some growers have had good results with larger disks and pressures lower than 150 pounds.
6. Spray trunks and leaders thoroughly, including all the rough bark, holes, crotches, and cracks. Drench from at least three directions. Average-sized trees will require 3 1/2 to 4 gallons of spray. Do not apply spray to the rest of the tree, for it will cause injury to the buds.
7. When the spraying is completed, the entire spraying equipment must be thoroughly cleaned out to prevent the trunk spray from mixing with later sprays. Some yellow color will persist, but it is harmless.
8. Do not spray with lime-sulfur before applying the trunk spray or within a week thereafter. Lime-sulfur seems to reduce the effectiveness of the trunk spray.
9. Since the trunk spray stains readily, rubber gloves and a mask with a top and a cape down the front and back should be worn.

A thorough application of trunk sprays should destroy most of the overwintering codling moth worms hit and thus reduce the moth population. Summer codling moth sprays should be applied as usual. It cannot yet be said that trunk sprays will take the place of any of the standard dormant or summer sprays.

Cost of Trunk Spraying

The penetrant formula will cost about 10 cents per gallon and the modified one about 5 cents. The cost for application will be about 1 1/2 to 2 cents per gallon.

Literature Cited

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1943. Controlling the codling moth with nonarsenicals. Wash. State Hort. Assoc. Proc. 39: 107-110.

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on the codling moth. (Scientific Note) Jour. Econ.
Ent. 39: 407-408.

The following firms are among those known to handle the ingredients of these formulas:

Dinitro-o-cresol:

Standard Agricultural Chemicals, Inc., Hoboken, N. J., and
Sacramento, Calif.
Glogau & Co., 538 South Clark St., Chicago, Ill.
Benzol Products Co., 237 South St., Newark, N. J.

Triton B-1956:

Rohm & Haas Co., 222 West Washington Square, Philadelphia 5,
Pa., and Oakland and South Gate, Calif.

Tergitol No. 7:

Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York 17, N. Y.

Sodium lauryl sulfate (Dreft):

Proctor & Gamble, Cincinnati, Ohio, and local dealers.
E. I. du Pont de Nemours & Co., Inc. (Grasselli Chemicals Dept.),
Wilmington 98, Del.

Butyl Cellosolve:

Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York 17, N. Y.

Trichloroethylene:

E. I. du Pont de Nemours & Co., Inc. (Electrochemical Dept.),
350 Fifth Ave., New York 17, N. Y.
Dow Chemical Co. (Great Western Division), 310 Sansome St.,
San Francisco 4, Calif.
McKesson & Robbins, Inc. (Industrial Chemical Division),
155 East 44th St., New York 17, N. Y.
Carrier-Stephens Co., 221 Depot St., Lansing 2, Mich.
Arthur S. LaPine & Co., 121 Hubbard St., Chicago 10, Ill.
Westvaco Chlorine Products Corp., 405 Lexington Ave.,
New York 17, N. Y.

Ferric chloride:

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza,
New York 20, N. Y.
E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.
Dow Chemical Co. (Great Western Division), 310 Sansome St.,
San Francisco 4, Calif.
Mallinckrodt Chemical Works, Second and Mallinckrodt Sts.,
St. Louis 7, Mo.
Merck & Co., Inc., Rahway, N. J.
Monsanto Chemical Co., 1700 South Second St., St. Louis 4, Mo.

Stove oil and Diesel oil can be obtained locally from fuel oil dealers wherever the spray is to be prepared.

The proprietary trunk spray concentrate and the ferric chloride can be had from the following firms:

Yakima Valley Spray Co., California Spray-Chemical Corp.,
and the Farmers' Supply, all of Yakima, Wash.

This incomplete list is given for information only and does not imply a recommendation of the product of any particular company. No discrimination is intended against firms not listed, nor are the products of companies listed endorsed or guaranteed.

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